SOLAR/1051-79/06

Monthly Performance Report

COLORADO SUNWORKS

JUNE 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT
COLORADO SUNWORKS
JUNE 1979

I. SYSTEM DESCRIPTION

The Colorado Sunworks solar energy system is a passive solar energy system used for both space heating and domestic hot water preheating of a single-family dwelling located in Longmont, Colorado. The building is a three bedroom single-story house with approximately 1,800 square feet of living space as illustrated in Figure 1.

The passive space heating system, illustrated schematically in Figure 2, is a combination drum wall and direct gain system. Sunlight enters the double-glazed windows (approximately 300 square feet) on the south side of the building where the majority of the energy is absorbed by the black painted 55-gallon water-filled drums (54 drums total). The remainder of the energy is either absorbed in the 6-inch thick concrete slab floor or used to satisfy the daytime space heating demand. The 8-inch thick exterior insulated reinforced concrete building walls also serve as a secondary solar storage mass.

At night, or during periods of low incident solar energy, heat losses through the glazing are reduced by using movable insulation in the form of a Beadwall.* The Beadwall is constructed using the two panes of glass spaced 5-1/2 inches apart. Beads of white-colored rigid insulation can be blown into the space between the glass or sucked out using electrically driven blowers. When not used for south wall insulation, the beads of insulation are stored in tanks located in the garage. Operation of the Beadwall is automatically controlled based on sensors measuring incident solar energy and inside and outside temperature. This automatic operation may be manually overridden.

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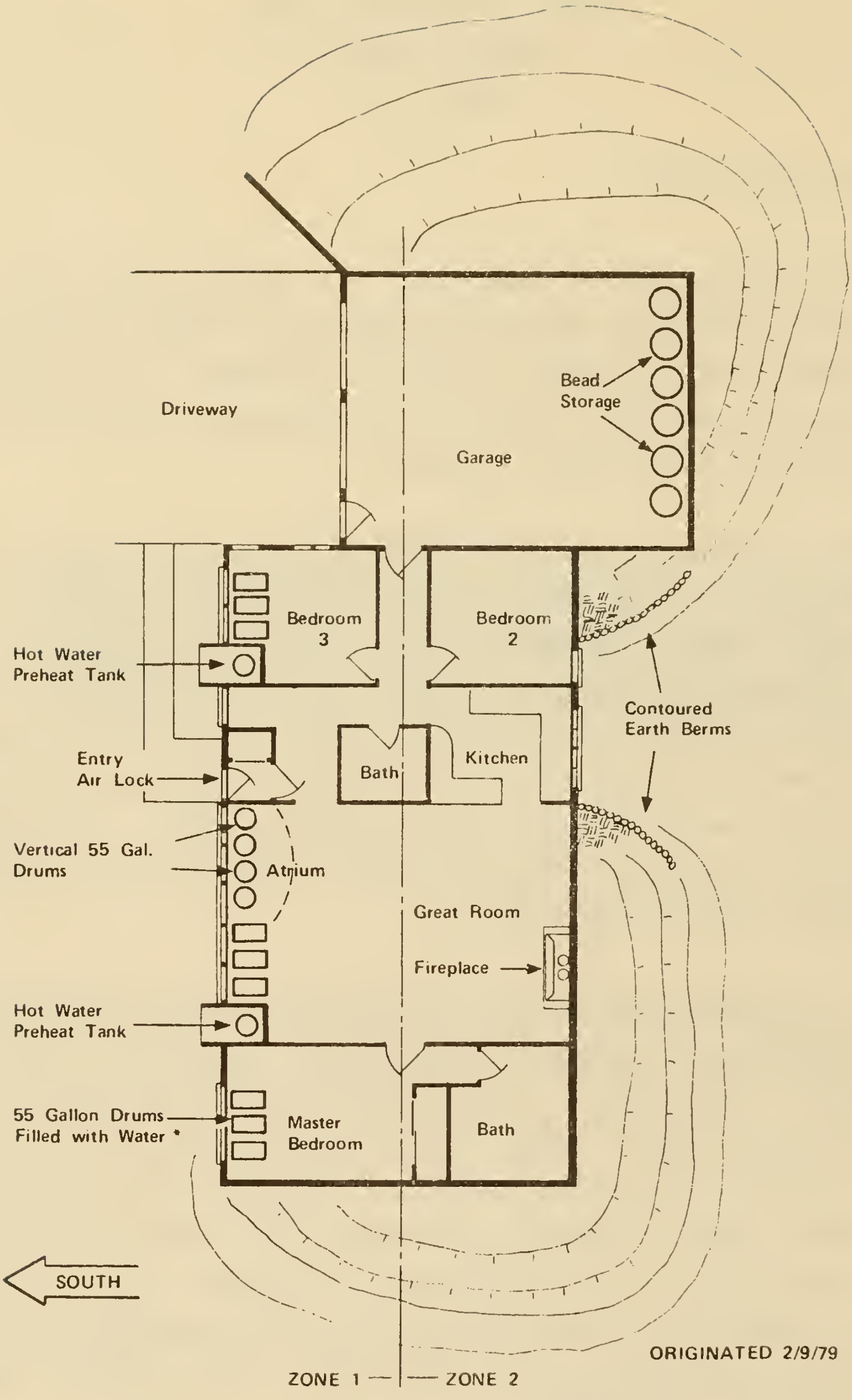
* Beadwall® is a registered trademark of the Zomeworks Corporation, Albuquerque, NM.



* all drums are stacked horizontally except in the Atrium where a single stack is placed vertically.

plan view

Figure 1. COLORADO SUNWORKS PASSIVE SOLAR SPACE HEATING SYSTEM

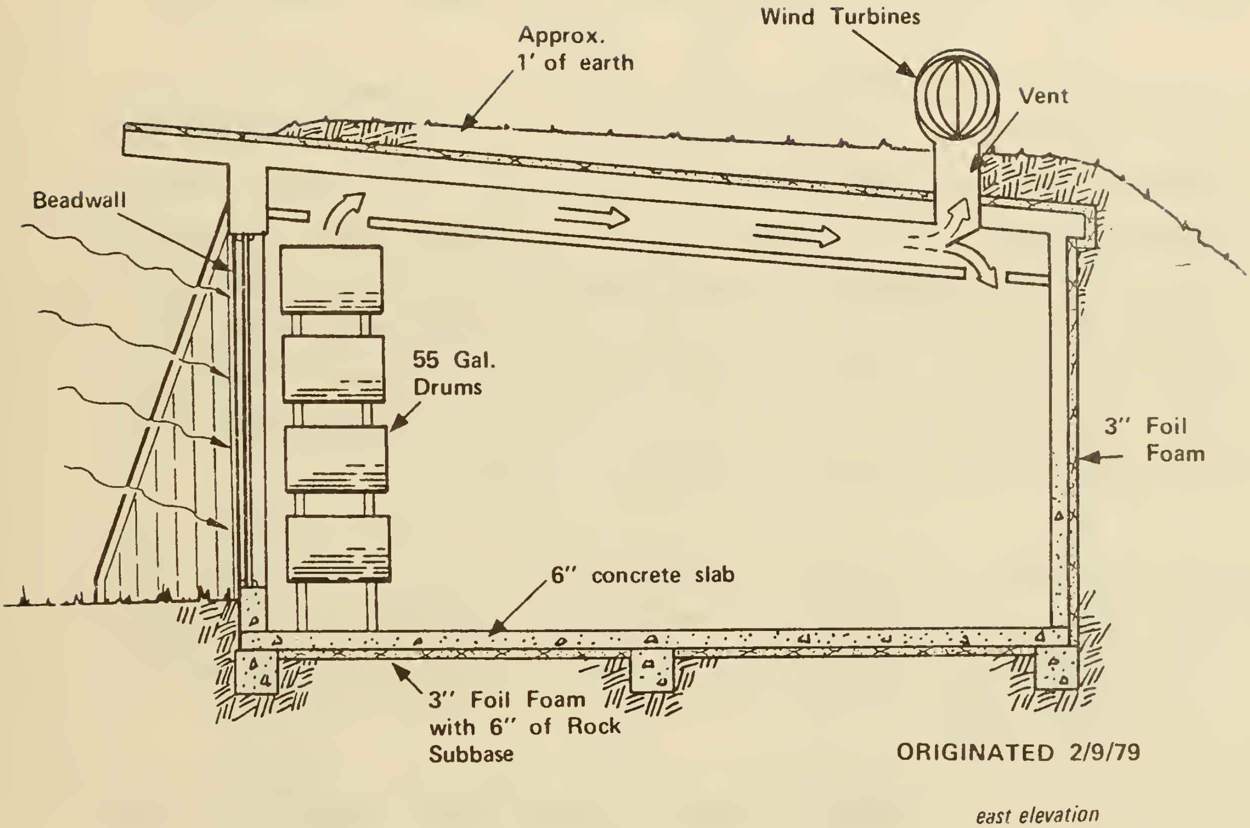


Figure 2. COLORADO SUNWORKS PASSIVE SOLAR SPACE HEATING SYSTEM

Distribution of the collected solar energy to the house is by both convection and radiation. A unique feature of this building is the technique used for distribution of collected solar energy from the drums to the north side of the house. The vertically stacked drums near the south wall form a drumwell chimney where heated air rises through ceiling vents above the drums into an open plenum area between the roof and the ceiling of the rooms. Additional vents from this plenum on the north side of the house provide a path for the warm air into the room, thus providing for a thermosiphon flow around the inside of the building.

The building design and construction makes use of a number of energy conserving features. The exterior skin of the building (including the bottom of the slab floor) is well insulated and sealed. Earth berms on the north, east, and west sides of the house provide additional insulation along with a damping of the extremes in temperature variation of the outside skin of the house. The roof is also covered with approximately one foot of earth. Additional energy conserving features include the use of an entry vestibule to serve as an airlock and the placement of the garage to the northwest to serve as a windbreak.

Auxiliary space heating energy is provided by either natural gas-fired hydronic baseboard units or by a wood-burning fireplace. The fireplace has a provision for recirculation of room air while providing outside air for combustion.

The passive solar domestic hot water system (Figure 3) consists of two 30-gallon tanks which have been stripped of their insulation, painted black, and positioned next to the south wall (Figure 1). Domestic hot water is preheated in these tanks before passing on demand to the natural gas-fired domestic hot water tank where it is raised to operating temperature. The preheat tanks are insulated from the living space by interior walls, and are insulated from the outside conditions at night using the Beadwall movable insulation. Reflective surfaces inside the insulated spaces enhance the absorption of incident solar radiation.

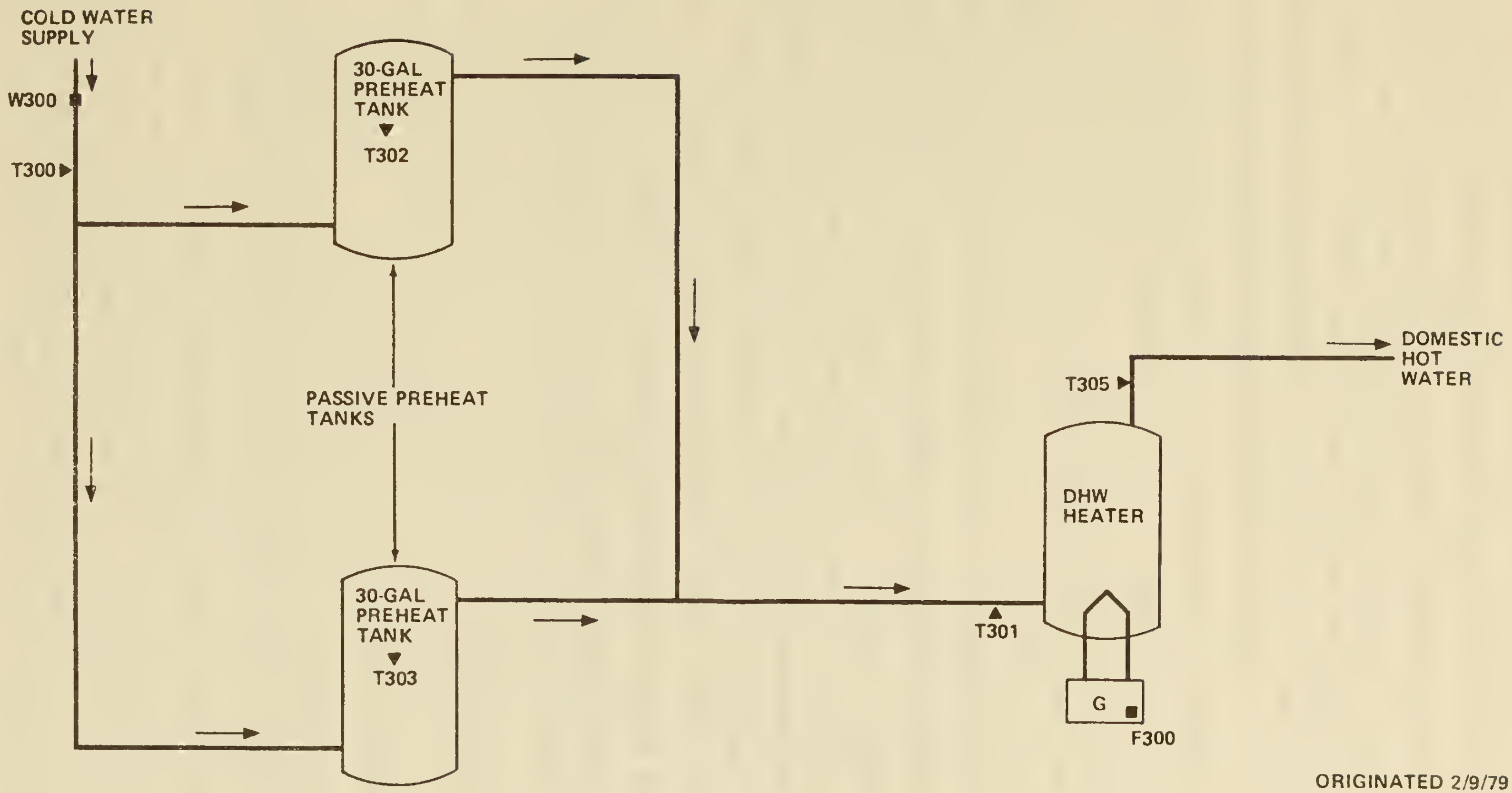


Figure 3. COLORADO SUNWORKS PASSIVE SOLAR DOMESTIC HOT WATER SYSTEM SCHEMATIC

Summer overheat protection is provided by several means. A roof overhang over the south wall provides shading from the high summer sun. The Beadwall movable insulation can be closed during the day to prevent solar radiation from entering the building. Cooling of the building is enhanced by the use of nighttime ventilation. Cool outside air can enter the house through open windows, passing over the solar storage masses and removing energy before exiting the building through roof vents located in the plenum area between the ceiling and roof. This natural flow is enhanced by the use of wind turbines above the roof vents as illustrated in Figure 2. When the house is closed during the daytime hours, the cooled solar storage masses absorb energy, thus tempering conditions inside the living space.

Predicted solar contribution for this system is 65 percent of the energy requirements for space heating and domestic hot water. The building is located near Longmont, Colorado (north of Denver) on a plain at least 10 miles east of significant changes in the terrain elevation. The average annual heating requirement for this area is over 6,000 heating degree-days. Long-term monthly average outside ambient temperatures range from 30°F in January to 73°F in July. Relative humidity is generally quite low. The average annual percentage of available sunlight is 64 percent. The most significant local climate effects are the high surface winds typically encountered during periods of changing weather conditions.

II. PERFORMANCE ANALYSIS

A. Introduction

The June report begins the summer season evaluation of the Colorado Sunworks space heating system. During warm weather operation, the primary thermal performance concern for a passive space heating system is potential overheating of the conditioned space. Building temperatures in June remained below 80°F during the entire month as the occupants were able to effectively utilize the system controls to prevent overheating. The solar domestic hot water system continued to operate, satisfying 21 percent of the hot water load.

B. Weather

The daily average incident solar energy during June was 648 Btu/ft^2-day, less than the long-term average of 838 Btu/ft^2-day derived from measurements at the nearby Denver, Colorado weather station. The average outside ambient temperature of 66°F was the same as the long-term average. Surface winds were occasionally quite high, particularly on June 19, when the daily average wind speed was greater than 10 miles per hour.

C. System Thermal Performance

Domestic Hot Water - The solar energy absorbed in the two domestic hot water preheat tanks satisfied 21 percent of the domestic hot water demand of 1.61 million Btu by supplying 0.41 million Btu of solar energy from the preheat tanks. An average of 88 gallons of hot water were used each day by the four-member family living in the house. The solar contribution never reaches zero, even after the water in the preheat tanks has been completely replaced. This is due to energy transfer from the house (74°F) to the water in the preheat tanks (cold supply water temperature averages 55°F) since the preheat tanks are not completely thermally isolated from the interior of the building. Approximately 2.81 million Btu of natural gas was used as auxiliary fuel by the hot water heater. Assuming a conversion efficiency of 60 percent, then 1.69 million Btu of auxiliary thermal energy was delivered to the hot water. Using the assumed efficiency of 60 percent, the fossil fuel savings due to the hot water solar energy system are estimated to be 0.69 million Btu (690 cubic feet*) of natural gas. Daily variations in hot water solar fraction and hot water energy savings are due to variations in incident solar energy and daily variations in the hot water use, both in time of use and amount of use.

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* Assumes 1,000 Btu per cubic foot.

Space Heating - During June the application of system controls by the occupants was satisfactory in preventing any significant overheating of the conditioned space. The average building temperature was a comfortable 74°F. Building temperatures near 80°F were observed only in the late afternoon near the end of the month as daily average outside ambient temperatures exceeded 70°F.

D. Observations

Several changes to the numbers in the attached computer printout are made for warm weather reporting of passive systems. The building is assumed to have a zero heating load. Performance factors relating to energy collection do not apply for the warm weather periods since the task for a passive heating system in the summer is energy rejection rather than energy collection.

E. Energy Savings

Fossil energy savings for the solar energy systems were 690 cubic feet of gas due to the solar hot water preheat system. The power necessary to operate the Beadwall nighttime insulation system was 34 kwh. This energy is applied as a penalty to energy savings.

Total estimated energy consumption during June was 477 kwh of electrical energy, 2,822 cubic feet of natural gas, and 0.41 million Btu of solar energy.

III. ACTION STATUS

At the next site visit, the sensor used to sense fireplace operation is to be changed from a thermal switch to a surface temperature measurement.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: COLORADO SUNWORKS   LONGMONT, COLORADO   SOLAR/1051-79/06
REPORT PERIOD: JUNE,1979

SITE/SYSTEM DESCRIPTION:
THE COLORADO SUNWORKS SOLAR ENERGY SYSTEM PROVIDES SPACE HEATING AND DOMESTIC HOT WATER PREHEATING. THE PASSIVE HEATING SYSTEM CONSISTS OF A DRUMWALL COLLECTOR/STORAGE UNIT USED IN CONJUNCTION WITH A BEADWALL, TWO 30 GALLON TANKS POSITIONED NEXT TO THE SOUTH WALL AND INSULATED FROM THE INTERIOR LIVING SPACE. ENERGY CONSERVING FEATURES INCLUDE INCREASED INSULATION, THE USE OF BERMS ON THE NORTH, EAST AND WEST SIDES, AN AIRLOCK AND THE PLACEMENT OF THE GARAGE TO THE NORTHWEST TO SERVE AS A WINDBREAK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	5.831 MILLION BTU
	19454 BTU/SQ.FT.
COLLECTED SOLAR ENERGY	N.A. MILLION BTU
	N.A. BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	66 DEGREES F
AVERAGE BUILDING TEMPERATURE	74 DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.07
ECSS OPERATING ENERGY	0.116 MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	0.116 MILLION BTU
TOTAL ENERGY CONSUMED	3.342 MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.612	0.000	N.A.	1.612 MILLION BTU
SOLAR FRACTION	21	0	N.A.	21 PERCENT
SOLAR ENERGY USED	0.411	0.000	N.A.	0.411 MILLION BTU
OPERATING ENERGY	N.A.	0.000	N.A.	0.116 MILLION BTU
AUX. THERMAL ENERGY	1.689	0.000	N.A.	1.689 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
AUX. FOSSIL FUEL	2.815	0.000	N.A.	2.815 MILLION BTU
ELECTRICAL SAVINGS	N.A.	N.A.	N.A.	-0.116 MILLION BTU
FOSSIL SAVINGS	0.685	0.000	N.A.	0.685 MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.504

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: COLORADO SUNWORKS LONGMONT, COLORADO SOLAR/1051-79/06
REPORT PERIOD: JUNE,1979

SITE/SYSTEM DESCRIPTION:
THE COLORADO SUNWORKS SOLAR ENERGY SYSTEM PROVIDES SPACE HEATING AND DOMESTIC HOT WATER PREHEATING. THE PASSIVE HEATING SYSTEM CONSISTS OF A DRUMWALL COLLECTOR/STORAGE UNIT USED IN CONJUNCTION WITH A BEADWALL, TWO 30 GALLON TANKS POSITIONED NEXT TO THE SOUTH WALL AND INSULATED FROM THE INTERIOR LIVING SPACE. ENERGY CONSERVING FEATURES INCLUDE INCREASED INSULATION, THE USE OF BERMS ON THE NORTH, EAST AND WEST SIDES, AN AIRLOCK AND THE PLACEMENT OF THE GARAGE TO THE NORTHWEST TO SERVE AS A WINDBREAK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	6.151	GIGA JOULES
	220922	KJ/SQ.M.
COLLECTED SOLAR ENERGY	N.A.	GIGA JOULES
	N.A.	KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	19	DEGREES C
AVERAGE BUILDING TEMPERATURE	23	DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.07	
ECSS OPERATING ENERGY	0.122	GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	0.122	GIGA JOULES
TOTAL ENERGY CONSUMED	3.525	GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL	
LOAD	1.700	0.000	N.A.	1.700	GIGA JOULES
SOLAR FRACTION	21	0	N.A.	21	PERCENT
SOLAR ENERGY USED	0.434	0.000	N.A.	0.434	GIGA JOULES
OPERATING ENERGY	N.A.	0.000	N.A.	0.122	GIGA JOULES
AUX. THERMAL ENG	1.782	0.000	N.A.	1.782	GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A.	GIGA JOULES
AUX. FOSSIL FUEL	2.970	0.000	N.A.	2.970	GIGA JOULES
ELECTRICAL SAVINGS	N.A.	N.A.	N.A.	-0.122	GIGA JOULES
FOSSIL SAVINGS	0.723	0.000	N.A.	0.723	GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.504

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978. SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: COLORADO SUNWORKS   LONGMONT, COLORADO   SOLAR/1051-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.228	52	N	N	0.004	N	0.019
2	0.235	60	O	O	0.006	O	0.070
3	0.239	66	T	T	0.004	T	0.081
4	0.235	70			0.004		0.086
5	0.233	71	A	A	0.004	A	0.099
6	0.217	68	P	P	0.005	P	0.072
7	0.011	50	P	P	0.004	P	1.194
8	0.041	44	L	L	0.003	L	0.097
9	0.169	49	I	I	0.003	I	0.049
10	0.199	58	C	C	0.004	C	0.079
11	0.206	67	A	A	0.003	A	0.101
12	0.208	73	B	B	0.004	B	0.059
13	0.218	74	L	L	0.004	L	0.058
14	0.204	73	E	E	0.003	E	0.058
15	0.164	68			0.002		0.048
16	0.185	65			0.003		0.040
17	0.202	64			0.003		0.055
18	0.179	64			0.004		0.137
19	0.185	59			0.005		0.037
20	0.205	67			0.004		0.040
21	*	*			*		*
22	0.216	72			0.005		0.095
23	*	*			*		*
24	0.206	71			0.003		0.128
25	0.211	73			0.002		0.044
26	*	*			*		*
27	0.224	75			0.005		0.057
28	0.232	73			0.004		0.071
29	0.199	74			0.006		0.065
30	0.194	72			0.004		0.039
SUM	5.831	-	N.A.	N.A.	0.116	N.A.	-
AVG	0.194	66	N.A.	N.A.	0.004	N.A.	0.070
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: COLORADO SUNWORKS   LONGMONT, COLORADO   SOLAR/1051-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.228	0.158	N	63	N
2	0.235	0.160	O	71	O
3	0.239	0.181	T	80	T
4	0.235	0.196		83	
5	0.233	0.193	A	85	A
6	0.217	0.169	P	81	P
7	0.011	0.014	P	52	P
8	0.041	0.021	L	49	L
9	0.169	0.117	I	53	I
10	0.199	0.151	C	69	C
11	0.206	0.077	A	80	A
12	0.208	0.155	B	86	B
13	0.218	0.156	L	93	L
14	0.204	0.170	E	87	E
15	0.164	0.124		81	
16	0.185	0.165		76	
17	0.202	0.182		74	
18	0.179	0.161		72	
19	0.185	0.143		64	
20	0.205	0.169		79	
21	*	*		*	
22	0.216	0.195		84	
23	*	*		*	
24	0.206	0.180		84	
25	0.211	0.187		88	
26	*	*		*	
27	0.224	0.175		82	
28	0.232	0.209		89	
29	0.199	0.151		87	
30	0.194	0.130		88	
SUM	5.831	4.541	N.A.	-	-
AVG	0.194	0.151	N.A.	77	N.A.
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATICN PROGRAM

MCNTHLY REPORT
HOT WATER SUBSYSTEM

SITF: COLORADO SUNWORKS LONGMONT, COLORADO SOLAR/1051-79/06
REPORT PERIOD: JUNE,1979

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.025	39	0.004	N	0.039	N	0.065	N	0.007	54	133	52
2	0.052	23	0.016	O	0.059	O	0.098	O	0.027	53	133	76
3	0.063	22	0.019	T	0.061	T	0.102	T	0.032	53	133	105
4	0.065	25	0.020		0.066		0.110		0.034	53	134	97
5	0.065	29	0.023	A	0.065	A	0.108	A	0.038	53	132	102
6	0.056	24	0.016	P	0.051	P	0.084	P	0.026	53	132	85
7	0.068	22	0.013	P	0.069	P	0.114	P	0.022	54	130	118
8	0.045	10	0.004	L	0.056	L	0.094	L	0.007	54	132	71
9	0.049	12	0.008	I	0.060	I	0.099	I	0.014	54	135	72
10	0.050	20	0.016	C	0.047	C	0.079	C	0.026	54	135	74
11	0.087	22	0.021	A	0.078	A	0.130	A	0.035	54	128	141
12	0.034	23	0.012	B	0.040	B	0.066	B	0.021	54	127	51
13	0.035	24	0.013	L	0.040	L	0.067	L	0.021	54	134	53
14	0.037	24	0.012	E	0.043	E	0.071	E	0.020	54	129	71
15	0.093	12	0.008		0.101		0.168		0.013	54	132	164
16	0.028	11	0.007		0.040		0.067		0.012	54	134	42
17	0.037	21	0.011		0.039		0.066		0.018	55	122	79
18	0.116	21	0.024		0.102		0.170		0.041	55	131	179
19	0.035	16	0.007		0.040		0.067		0.011	55	132	56
20	0.033	16	0.008		0.039		0.066		0.014	55	132	53
21	*	*	*		*		*		*	*	*	*
22	0.047	26	0.021		0.042		0.070		0.034	55	128	81
23	*	*	*		*		*		*	*	*	*
24	0.093	26	0.026		0.077		0.128		0.044	56	132	145
25	0.035	19	0.009		0.066		0.110		0.015	56	134	60
26	*	*	*		*		*		*	*	*	*
27	0.050	21	0.013		0.050		0.083		0.021	56	123	93
28	0.043	24	0.016		0.037		0.062		0.027	57	129	73
29	0.090	18	0.013		0.088		0.146		0.022	57	129	146
30	0.020	17	0.007		0.025		0.042		0.012	57	131	34
SUM	1.612	-	0.411	N.A.	1.689	N.A.	2.815	N.A.	0.685	-	-	2637
AVG	0.054	21	0.014	N.A.	0.056	N.A.	0.094	N.A.	0.023	55	131	88
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NCT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMCNSTRATION PROGRAM

MCNTHLY REFORT
SPACE HEATING SUBSYSTEM

SITE: COLORADO SUNWORKS   LONGMONT, COLORADO   SCLAR/1051-79/06
REPORT PERIOD: JUNE,1979

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLICN BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.000	0	0.000	0.000	0.000	N	0.000	N	0.000	71	52
2	0.000	0	0.000	0.000	0.000	O	0.000	O	0.000	72	60
3	0.000	0	0.000	0.000	0.000	T	0.000	T	0.000	73	66
4	0.000	0	0.000	0.000	0.000		0.000		0.000	73	70
5	0.000	0	0.000	0.000	0.000	A	0.000	A	0.000	75	71
6	0.000	0	0.000	0.000	0.000	P	0.000	P	0.000	75	68
7	0.000	0	0.000	0.000	0.000	P	0.000	P	0.000	74	50
8	0.000	0	0.000	0.000	0.000	L	0.000	L	0.000	72	44
9	0.000	0	0.000	0.000	0.000	I	0.000	I	0.000	71	49
10	0.000	0	0.000	0.000	0.000	C	0.000	C	0.000	71	58
11	0.000	0	0.000	0.000	0.000	A	0.000	A	0.000	72	67
12	0.000	0	0.000	0.000	0.000	B	0.000	P	0.000	74	73
13	0.000	0	0.000	0.000	0.000	L	0.000	L	0.000	75	74
14	0.000	0	0.000	0.000	0.000	E	0.000	E	0.000	74	73
15	0.000	0	0.000	0.000	0.000		0.000		0.000	74	68
16	0.000	0	0.000	0.000	0.000		0.000		0.000	74	65
17	0.000	0	0.000	0.000	0.000		0.000		0.000	74	64
18	0.000	0	0.000	0.000	0.000		0.000		0.000	74	64
19	0.000	0	0.000	0.000	0.000		0.000		0.000	74	59
20	0.000	0	0.000	0.000	0.000		0.000		0.000	75	67
21	0.000	*	*	*	*		0.000		*	*	*
22	0.000	0	0.000	0.000	0.000		0.000		0.000	76	72
23	*	*	*	*	*		*		*	*	*
24	0.000	0	0.000	0.000	0.000		0.000		0.000	75	71
25	0.000	0	0.000	0.000	0.000		0.000		0.000	74	73
26	*	*	*	*	*		*		*	*	*
27	0.000	0	0.000	0.000	0.000		0.000		0.000	76	75
28	0.000	0	0.000	0.000	0.000		0.000		0.000	76	73
29	0.000	0	0.000	0.000	0.000		0.000		0.000	76	74
30	0.000	0	0.000	0.000	0.000		0.000		0.000	75	72
SUM	0.000	-	0.000	0.000	0.000	N.A.	0.000	N.A.	0.000	-	-
AVG	0.000	0	0.000	0.000	0.000	N.A.	0.000	N.A.	0.000	74	66
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NCT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: COLORADO SUNWORKS   LONGMONT, COLORADO   SOLAR/1051-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	762	N	52	63	68	*	5
2	783	O	60	71	56	57	2
3	797	T	66	80	47	0	2
4	785		70	83	39	0	2
5	776	A	71	85	42	0	2
6	724	P	68	81	52	95	8
7	37	P	50	52	89	127	4
8	138	L	44	49	98	105	6
9	564	I	49	53	83	62	6
10	662	C	58	69	66	155	2
11	689	A	67	80	59	0	2
12	695	B	73	86	52	0	1
13	727	L	74	93	51	194	2
14	682	E	73	87	39	258	4
15	549		68	81	63	91	4
16	617		65	76	72	78	5
17	674		64	74	80	119	7
18	596		64	72	69	39	9
19	618		59	64	46	297	12
20	686		67	79	36	132	6
21	*		*	*	*	*	*
22	720		72	84	42	68	5
23	*		*	*	*	*	*
24	689		71	84	56	51	2
25	705		73	88	50	*	7
26	*		*	*	*	*	*
27	748		75	82	54	67	4
28	775		73	89	59	64	4
29	666		74	87	53	33	3
30	646		72	88	53	130	6
SUM	19454	N.A.	-	-	-	-	-
AVG	648	N.A.	66	77	58	75	4
NBS ID	Q001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
PASSIVE SPACE HEATING

SITE: COLORADO SUNWORKS LONGMONT, COLORADO SOLAR/1051-79/06
REPORT PERIOD: JUNE,1979

DAY OF MON	SPACE HEATING LOAD MILLION BTU	SOLAR ENERGY USED MILLION BTU	CHANGE IN STORE ENERGY MILLION BTU	AVERAGE STORAGE TEMP DEG F	DIRECT SOLAR UTIL EFFIC	AUX THERMAL USED MILLION BTU	BLDG TEMP DEG F	AMB TEMP DEG F	WIND AVG SPEED MPH	WIND AVG DIR DEG	SOLAR FR LOAD PER CENT
1	0.000	0.000	0.008	72.8	0.019	0.000	71	52	4.8	*	0
2	0.000	0.000	0.004	73.1	0.070	0.000	72	60	2.1	57	0
3	0.000	0.000	0.016	73.8	0.081	0.000	73	66	1.8	0	0
4	0.000	0.000	0.021	74.4	0.086	0.000	73	70	1.7	0	0
5	0.000	0.000	0.020	75.3	0.099	0.000	75	71	1.7	0	0
6	0.000	0.000	0.012	75.8	0.072	0.000	75	68	7.7	95	0
7	0.000	0.000	-0.057	75.2	1.194	0.000	74	50	3.7	127	0
8	0.000	0.000	-0.045	73.3	0.097	0.000	72	44	6.0	105	0
9	0.000	0.000	-0.018	71.9	0.049	0.000	71	49	5.8	62	0
10	0.000	0.000	-0.002	71.2	0.079	0.000	71	58	2.3	155	0
11	0.000	0.000	0.021	71.6	0.101	0.000	72	67	1.8	0	0
12	0.000	0.000	0.028	72.4	0.059	0.000	74	73	1.4	0	0
13	0.000	0.000	0.020	73.5	0.058	0.000	75	74	2.4	194	0
14	0.000	0.000	-0.007	73.9	0.058	0.000	74	73	4.4	258	0
15	0.000	0.000	-0.007	73.6	0.048	0.000	74	68	4.2	91	0
16	0.000	0.000	0.020	73.8	0.040	0.000	74	65	5.1	78	0
17	0.000	0.000	-0.003	74.0	0.055	0.000	74	64	7.1	119	0
18	0.000	0.000	-0.007	73.6	0.137	0.000	74	64	9.1	39	0
19	0.000	0.000	0.002	73.8	0.037	0.000	74	59	11.7	297	0
20	0.000	0.000	0.009	73.9	0.040	0.000	75	67	5.5	132	0
21	0.000	*	0.010	*	*	*	*	*	*	*	*
22	0.000	0.000	0.011	74.8	0.095	0.000	76	72	4.8	68	0
23	*	*	*	*	*	*	*	*	*	*	*
24	0.000	0.000	-0.015	75.0	0.128	0.000	75	71	2.4	51	0
25	0.000	0.000	0.001	74.5	0.044	0.000	74	73	6.7	*	0
26	*	*	*	*	*	*	*	*	*	*	*
27	0.000	0.000	0.000	75.6	0.057	0.000	76	75	4.5	67	0
28	0.000	0.000	0.007	75.7	0.071	0.000	76	73	3.5	64	0
29	0.000	0.000	0.001	75.9	0.065	0.000	76	74	3.4	33	0
30	0.000	0.000	-0.011	75.6	0.039	0.000	75	72	5.8	130	0
SUM	0.000	0.000	0.042	-	-	0.000	-	-	-	-	-
AVG	0.000	0.000	0.001	74.0	0.070	0.000	74	66	4.5	75	0
NBS	Q402	Q400	Q202			Q401	N405	N113	N114	N115	N400

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
PASSIVE SYSTEM ENVIRONMENT

SITE: COLORADO SUNWORKS LONGMONT, COLORADO SOLAR/1051-79/06
REPORT PERIOD: JUNE,1979

DAY OF MON	BUILDING COMFORT ZONE 1	BLDG COMF ZONE 2	BUILDING TEMP MIDNIGHT DEG F	BUILDING TEMP 6 AM DEG F	BUILDING TEMP NOON DEG F	BUILDING TEMP 6 PM DEG F	INTERIOR RELATIVE HUMIDITY PERCENT	AMB TEMP DEG F	DAYTIME AMB TEMP DEG F	INCIDENT SOLAR ENERGY MILLION BTU	AVG STOR TEMP DEG F
1	72	71	71	69	71	73	45	52	63	0.228	73
2	73	72	73	70	73	75	44	60	71	0.235	73
3	73	72	73	71	74	75	43	66	80	0.239	74
4	74	72	74	70	74	76	38	70	83	0.235	74
5	75	73	75	72	75	77	40	71	85	0.233	75
6	76	74	76	72	76	78	38	68	81	0.217	76
7	74	74	72	74	74	73	43	50	52	0.011	75
8	72	72	71	72	72	72	43	44	49	0.041	73
9	71	71	70	70	71	72	44	49	53	0.169	72
10	71	71	72	68	71	73	46	58	69	0.199	71
11	72	72	73	70	73	74	49	67	80	0.206	72
12	73	73	74	71	74	76	51	73	86	0.208	72
13	74	74	72	73	75	77	50	74	93	0.218	74
14	74	73	71	71	76	77	43	73	87	0.204	74
15	74	73	72	71	75	76	46	68	81	0.164	74
16	74	74	74	72	76	77	50	65	76	0.185	74
17	74	74	72	72	76	76	50	64	74	0.202	74
18	74	73	74	71	74	76	51	64	72	0.179	74
19	74	74	74	72	74	75	45	59	64	0.185	74
20	74	74	73	73	75	77	43	67	79	0.205	74
21	*	*	76	71	76	*	*	*	*	*	*
22	75	75	75	74	77	78	43	72	84	0.216	75
23	*	*	74	*	*	77	*	*	*	*	*
24	75	74	73	72	76	78	46	71	84	0.206	75
25	75	74	75	70	76	77	48	73	88	0.211	74
26	*	*	75	*	*	*	*	*	*	*	*
27	76	76	75	74	77	79	48	75	82	0.224	76
28	76	75	75	72	77	80	47	73	89	0.232	76
29	76	75	75	73	77	80	46	74	87	0.199	76
30	76	75	74	72	77	78	44	72	88	0.194	76
SUM	-	-	-	-	-	-	-	-	-	5.831	-
AVG	74	73	73	72	75	76	45	66	77	0.194	74
NBS								N113			

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
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*U.S. GOVERNMENT PRINTING OFFICE: 1979-640-189/4103. Region 4.